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MULTICOMPONENT HYDROGELS AS SMART MATERIALS FOR DRUG DELIVERY, DISEASE MODELING AND *EX VIVO* TISSUE PRODUCTION

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Abstract. Material requirements for biological and medical applications are rapidly shifting from being simply non-toxic or biocompatible towards biomimetic three-dimensional structures capable of supporting *de novo* engineered living tissues. Multi-parameter matrices allowing for the precise control of biochemical properties (e.g. biodegradation, adhesion ligands, soluble effectors etc.) independently from mechanical network parameters are crucial for successfully engineering artificial biological systems. The formation of such materials demands novel chemistry which should be both bio-orthogonal and spatially specific. In this presentation I highlight the recent progress of our lab in the development of orthogonal synthetic strategies for the formation [1–2] and functionalization [3–4] of biodegradable biohybrid hydrogels composed of covalently crosslinked four-arm poly(ethylene glycol) (starPEG) and various glycosaminoglycan (GAG) polysaccharides with peptide conjugates. These multicomponent hydrogels were utilized to create a new smart material approach for disease modeling [5] as well as protein and drug delivery applications [6–7].

The combination of polymer materials with an orthogonal enzymatically degradable peptide concept was utilized to create a new bio-orthogonal approach for *ex vivo* tissue regeneration. Implementation of polymer-peptide conjugates as crosslinking points in the hydrogel polymer network allows “on demand” polymer degradation for the gentle release of the formed tissue from the supporting material, while simultaneously keeping its cellular and extracellular matrix organisation untouched. We showed the perspective of this technique by the creation of corneal endothelial lamella [8], which from one side is a very simple cell monolayer tissue, but from another is extremely challenging in the production because of its very fragile nature. Our proposed synthetic technique allows for the first time the formation of physiologically relevant size human cornea endothelial lamella tissue suitable for surgical implantation in descemet membrane endothelial keratoplasty (DMEK).

References

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